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II.

ON THE SOLAR MOTION IN SPACE AND THE STELLAR DISTANCES.

(*Second Paper.*)

By Truman Henry Safford.

In a previous paper, I have examined some of the older known proper motions, and shown that they are favorable to the assumption that the distances of the stars are, upon the average, inversely proportional to their proper motions. We cannot expect that this will be equally true in all regions of the heavens. It will be necessary, as materials accumulate for the study of this problem, and other collateral ones, to pursue the investigation more into detail; including more stars, and examining their motions as related to their position on the celestial sphere, and especially to the apex of solar motion. The present paper contains such a detailed investigation for an important class of stars. Those here investigated are the two hundred and fifty whose proper motions Argelander has discussed in the seventh volume of the Bonn Observations, Part I.; I am myself preparing for another purpose a similar discussion of about one hundred and fifty more, and other material of the same kind is soon to be published in great quantities. So that the present paper is also of use in fixing the form of the discussion.

From the formulæ, —

$$\begin{aligned}
\cos\chi &= \sin D \sin\delta + \cos D \cos\delta \cos(\alpha - A)\,;\\
\sin\chi \cos\psi' &= -\sin D \cos\delta + \cos D \sin\delta \cos(\alpha - A)\,;\\
\sin\chi \sin\psi' &= \cos D \sin(\alpha - A)\,;\\
\Delta\alpha \cos\delta &= \Delta\varsigma \sin\psi\,;\\
\Delta\delta &= \Delta\varsigma \cos\psi\,;
\end{aligned}$$

where

α, δ, the star's right ascension and declination,

$\Delta\alpha$, $\Delta\delta$, its annual proper motion in these co-ordinates,

A, D, the right ascension and declination of the apex of solar motion assumed known,

χ, the star's angular distance from the apex,

ψ', the angle of position at the star of the arc of a great circle directed away from the apex,

ψ, the angle of position of the star's apparent motion,

are calculated the values of the following table.

I have assumed as before, —

$$A = 259^\circ 50'8 \quad D = 32^\circ 29'1.$$

I noticed, too late for use in this series, that if we put

$$\begin{aligned} \sin m \sin M &= \sin D\,; \\ \sin m \cos M &= \cos D \cos (\alpha - A), \end{aligned}$$

we can more readily use the formulæ, which then become

$$\begin{aligned} \cos \chi &= \sin m \cos (\delta - M); \\ \sin \chi \cos \psi' &= \sin m \sin (\delta - M)\,; \\ \sin \chi \sin \psi' &= \cos D \sin (\alpha - A) = \cos m, \end{aligned}$$

or

$$\tan \psi' = \frac{\cot m}{\sin (\delta - M)}\,;$$

$$\sin \chi = \frac{\cos m}{\sin \psi'},$$

by tabulating m, M, and log. cot m, log. cos m, or like functions, with the argument α.

In the following table, the stars are indicated by Argelander's numbers, and arranged in the order of their annual proper motions, the largest (Groombridge, 1830) first.

The columns contain in their order the star's number, Argelander's values of $\Delta\,\varsigma$ and ψ (Bonner Beobachtungen, Bd. VII. S. 109–113), and those of ψ', $\psi' - \psi$, and log. sin χ, which I have computed by the preceding formulæ.

In order to get an approximate idea of what these stars indicate, with reference to the relation between distance and annual motion, I have taken the means of the cosines of $\psi' - \psi$ in groups of twenty-five stars each; the means of the natural sines of χ are not systematically variable to any great extent throughout the table.

Group.	Value of $\Delta\,s$.	Mean $(\cos(\psi' - \psi))$
I.	7″053 — 1″171	0.586
II.	1. 103 — 0. 707	0.615
III.	0. 697 — 0. 583	0.468
IV.	0. 582 — 0. 489	0.390
V.	0. 485 — 0. 438	0.587
VI.	0. 435 — 0. 350	0.588
VII.	0. 348 — 0. 291	0.403
VIII.	0. 290 — 0. 249	0.582
IX.	0. 247 — 0. 185	0.592
X.	0. 184 — 0. 079	0.747
	General mean	0.556

The mean sine of χ is about equal to the integral

$$\int_0^{\frac{1}{2}\pi} \sin^2 \chi \, \delta \chi$$

divided by the integral

$$\int_0^{\frac{1}{2}\pi} \sin \chi \, \delta \chi$$

or unity; hence equal to $\frac{1}{4}\pi = 0.7854$.

The value of $\frac{\zeta}{r \Delta s}$ will then, from the present series, be roughly equal to $0.556 \div 0.785 = 0.708$, with a probable error of about $\pm$ 0.023.

But it will be noticed that in the present group of stars the values of cos. $(\psi' - \psi)$ *increase* as the proper motions become smaller; in the former paper they appeared to *decrease;* making it still more probable that the variations in both series arise from the errors of observation, and the very various regions in which the stars are situated, and not from any general deviation from constancy in the ratio

$$\frac{\zeta}{r \Delta s}.$$

The value of this ratio, from the previous series, was found equal to 0.666 for forty-three groups of the largest proper motions, and to 0.46 for eleven groups of smaller, or in the mean about 0.622; the best of the two values agreeing nearly with the present determination.

This is sufficiently noteworthy, as the stars of the former series were, on the whole, those visible to the naked eye, or of the magnitudes one to six inclusive; of the present ones, very few are brighter than the sixth, and many are of the eighth and ninth; so that so far the phenomena indicate hardly any dependence upon magnitude. In a future paper, I shall discuss a considerable number of other notable proper motions, which I myself have been lately employed in determining for a catalogue of latitude stars; and I intend to gradually accumulate materials for a more minute investigation of the whole subject, separating the stars according to their magnitudes and the region of the heavens in which they are situated.

The delicacy of the investigation is very great, owing to the danger of taking that for stellar motion which is simply the result of the errors of observation. Of course the old observers had indifferent instruments; but as a rule they used them well, if their work had plan and coherency enough to be preserved. Bradley's observations (1755) are still very accurate and indispensable; Piazzi and Groombridge (1800, 1810) are now old enough to determine many proper motions; the early work of Struve, Bessel, and Argelander (1814–1830), makes up in accuracy what it lacks in antiquity.

But too many of the modern observers are careless in their computations, and unsystematic in their plan of work; so that for many important stars there are no very late observations, while for many others a good many indifferent observations can be found and reduced with considerable trouble. The subject is becoming more and more chaotic, and will continue to do so, unless observers bind themselves by more rigid rules not to make observations save with the utmost precision, the most thorough system, and the most intelligent plan, directed towards a definite object. Of this fortunately there is good hope, as is shown in the interest in the great zones planned by Argelander, and now in progress under the auspices of the international "Astronomische Gesellschaft."

The next step in the discussion will be to include the more numerous proper motions soon to be determined. Of those which have already been computed, Argelander's older values, Lundahl's, have already been taken account of in my previous paper. These, with O. Struve's (which are nearly identical with a portion of Argelander's and Lundahl's and Main's), will shortly be redetermined in a more perfect manner, under Struve's and Auwers's direction, by a combination of Bradley's observations re-reduced with the Pulcova and Greenwich modern observations. Galloway's southern proper motions have been re-determined by the Melbourne observations, and those made at the Cape of Good Hope; but a careful study of these will be necessary, as good ancient observations in that region are scarce. The great northern zones will in a few years furnish many more.

Mädler's proper motions are, as I have before stated, rather precarious for some stars; he has criticised the ancient observations too hastily.

We are now justified in grouping any certain proper motions into normal places, taking in each case the total amount of proper motion as the unit; or at least in so classifying stars which are apparently near each other in the heavens, and not excessively far apart in amount of $\Delta \zeta$. We may regard it as settled that the star's distances are inversely proportional *upon the whole* to their proper motions.

TABLE OF INDIVIDUAL STARS.

Argelander's number.	Δs	ψ	ψ'	$\psi' - \psi$	log cos $(\psi' - \psi)$	log. sin χ
112	7″053	144°59′	246°43′	101°44′	9.3082 n	9.9604
104	4. 748	186 34	240 6	53 32	9.7741	9.9857
105	4. 403	282 22	242 24	— 39 58	9.8845	9.9767
2	2. 813	82 31	122 11	39 40	9.8864	9.9879
31	2. 359	51 54	136 20	84 26	8.9868	9.9193
140	2. 325	128 6	240 49	112 43	9.5868 n	9.8999
49	2. 236	126 1	160 51	34 50	9.9142	9.9739
240	2. 093	82 35	106 59	24 24	9.9594	9.9448
156	2. 015	151 14	214 52	63 38	9.6475	9.9546
70	1. 968	156 35	211 34	54 59	9.7588	9.9786
81	1. 688	247 30	225 11	— 22 19	9.9662	9.9950
181	1. 606	206 2	193 6	— 12 56	9.9888	9.7380
204	1. 527	221 41	114 8	—107 33	9.4793 n	9.7700
7	1. 436	90 19	114 58	24 39	9.9585	9.9479
177	1. 433	197 47	203 30	5 43	9.9978	9.7100
89	1. 426	249 25	235 0	— 14 25	9.9861	9.9878
78	1. 401	254 21	223 47	— 30 34	9.9350	9.9737
247	1. 383	135 58	122 42	— 13 16	9.9882	9.9991
43	1. 375	153 49	158 32	4 43	9.9985	9.9980
206	1. 333	101 15	143 47	42 32	9.8674	9.9779
161	1. 306	247 24	220 12	— 27 12	9.9491	9.8548
192	1. 269	197 8	6 23	169 15	9.9923 n	9.7700
76	1. 261	302 0	255 10	— 46 50	9.8351	9.8046
187	1. 207	208 54	180 23	— 28 31	9.9438	9.7013
71	1. 171	187 33	213 9	25 36	9.9551	9.9777
157	1. 103	296 16	294 32	— 1 44	9.9998	9.7477
74	1. 013	164 15	235 31	71 16	9.5067	9.8440
37	0. 997	133 37	149 18	15 41	9.9836	9.9954
120	0. 991	174 10	235 54	61 44	9.6754	9.9984
73	0. 969	201 2	216 4	15 2	9.9848	9.9853
133	0. 963	156 43	254 54	98 11	9.1534 n	9.8860
150	0. 944	294 13	221 11	— 73 2	9.4651	9.9376
203	0. 906	127 39	105 18	— 22 21	9.9660	9.7457
94	0. 891	172 21	237 39	65 18	9.6210	9.9841
137	0. 880	285 58	232 44	— 53 14	9.7771	9.9574
211	0. 870	86 50	128 2	41 12	9.8765	9.9021
126	0. 868	160 47	232 20	71 33	9.5004	9.9962
127	0. 864	281 0	233 7	— 47 53	9.8265	9.9870
218	0. 859	186 42	118 7	— 68 35	9.5625	9.9014
185	0. 848	7 49	343 3	— 24 46	9.9581	9.4214
228	0. 843	86 5	120 22	34 17	9.9171	9.9700
8	0. 816	69 27	124 18	54 51	9.7602	9.9872
85	0. 788	178 25	229 27	51 2	9.7986	9.9979
173	0. 741	162 42	212 28	49 46	9.8102	9.7166
52	0. 733	125 14	169 31	44 17	9.8549	9.9853

TABLE OF INDIVIDUAL STARS (*continued*).

Argelander's number.	Δs	ψ	ψ'	$\psi' - \psi$	log. cos $(\psi' - \psi)$	log. sin χ
20	0″730	110°37′	131°53′	21°16′	9.9694	9.9786
129	0.719	173 34	236 55	63 21	9.6518	9.9584
61	0.719	135 49	183 44	47 55	9.8262	9.9725
198	0.707	177 43	151 56	— 25 47	9.9545	9.9658
39	0.707	27 13	104 27	77 14	9.3444	9.6806
221	0.697	240 43	133 37	—107 6	9.4685 n	9.9947
114	0.690	214 10	250 26	36 16	9.9065	9.9466
53	0.688	144 7	171 45	27 38	9.9474	9.9913
65	0.681	121 15	199 10	77 55	9.3208	9.9972
46	0.678	147 46	158 31	10 45	9.9923	9.9748
77	0.669	207 12	219 37	12 25	9.9898	9.9995
111	0.666	247 44	250 3	2 19	9.9996	9.9516
215	0.667	38 40	63 22	24 42	9.9583	9.8788
63	0.666	185 16	194 7	8 51	9.9948	9.9654
21	0.652	113 18	133 52	20 34	9.9714	9.9844
219	0.643	209 43	68 30	—141 13	9.8918 n	9.8827
110	0.640	273 10	247 51	— 25 19	9.9562	9.9588
9	0.639	185 45	124 17	— 61 28	9.6792	9.9832
196	0.636	346 27	59 59	73 32	9.4525	9.6490
33	0.626	222 40	143 50	— 78 50	9.2870	9.9838
97	0.624	158 52	239 14	80 22	9.2236	9.9815
200	0.623	231 14	54 17	—176 57	9.9994 n	9.7447
12	0.623	82 9	127 4	44 55	9.8501	9.9805
246	0.619	40 11	112 10	71 59	9.4904	9.9583
212	0.618	39 21	59 6	19 45	9.9736	9.8765
225	0.604	235 45	97 28	—138 17	9.8730 n	9.9042
145	0.600	244 46	224 40	— 20 6	9.9727	9.9873
207	0.597	63 15	59 59	— 3 16	9.9993	9.8316
210	0.591	46 56	139 1	92 5	8.5605 n	9.9804
238	0.583	76 44	99 12	22 28	9.9657	9.9300
191	0.582	152 15	5 59	—146 16	9.9199 n	9.6935
64	0.582	141 39	252 16	110 37	9.5467 n	9.5224
106	0.577	110 43	239 46	129 3	9.7994 n	9.9885
217	0.572	175 1	124 48	— 50 13	9.8061	9.9233
60	0.571	179 49	182 9	2 20	9.9996	9.9989
24	0.561	124 1	138 35	14 34	9.9858	9.9826
243	0.558	101 32	122 18	20 46	9.9708	9.9989
224	0.556	222 52	112 1	—110 51	9.5514 n	9.9267
199	0.547	295 0	98 2	163 2	9.9807 n	9.6564
80	0.546	248 57	240 6	— 8 51	9.9948	9.9044
241	0.542	92 51	122 32	29 41	9.9389	9.9996
59	0.542	279 8	181 34	— 97 34	9.1195 n	9.9975
117	0.538	174 41	237 44	63 3	9.6563	9.9932
190	0.536	270 0	2 13	92 13	8.5875 n	9.7582
176	0.516	318 14	218 14	—100 0	9.2397 n	9.4943

TABLE OF INDIVIDUAL STARS (*continued*).

Argelander's number.	Δs	ψ	ψ'	$\psi' - \psi$	log. cos $(\psi' - \psi)$	log. sin χ
14	0″516	138°48′	125°59′	— 12°49′	9.9890	9.9555
118	0. 514	277 22	237 4	— 40 18	9.8823	9.9965
91	0. 512	270 0	306 8	36 8	9.9072	9.9996
134	0. 510	266 11	261 48	— 4 23	9.9987	9.8738
26	0. 509	43 50	131 29	87 39	8.6128	9 9174
69	0. 497	274 2	210 28	— 63 34	9.6485	9.9590
175	0. 493	278 9	337 14	59 5	9.7108	9.7722
162	0. 493	257 35	249 38	— 7 57	9.9958	9.6740
88	0. 491	227 19	239 20	12 1	9.9904	9.9629
86	0. 489	204 12	234 25	30 13	9.9366	9 9833
220	0. 485	110 0	127 8	17 8	9.9803	9.9519
159	0. 481	205 23	217 41	12 18	9.9899	9.9157
234	0. 480	219 5	115 19	—103 46	9.3765 n	9.9631
113	0. 479	167 32	236 36	69 4	9.5530	9.9998
101	0. 476	256 7	237 48	— 18 19	9.9774	9.9946
201	0. 473	173 24	98 16	— 75 8	9.4092	9.6907
163	0. 472	153 36	316 22	162 46	9.9801 n	9.8066
125	0. 471	221 24	233 7	11 43	9.9909	9.9930
68	0. 469	245 59	204 54	— 41 5	9.8772	9.9498
195	0. 468	165 12	142 16	— 22 59	9.9642	9.6846
179	0. 466	331 38	346 56	15 18	9.9843	9.7717
45	0. 466	123 14	159 40	36 26	9.9056	8.9657
23	0· 466	216 37	129 8	— 87 29	8 6426	9.9196
58	0. 464	191 54	180 12	— 11 42	9.9909	9.9994
124	0. 462	248 47	262 40	13 53	9.9871	9.9039
226	0. 461	165 26	125 42	— 39 44	9.8859	9.9911
144	0. 460	262 30	250 12	— 12 18	9.9899	9.8619
141	0. 457	254 31	235 34	— 18 57	9.9758	9.9227
186	0. 455	300 30	351 41	51 11	9.7972	9.6639
99	0. 447	254 49	250 3	— 4 46	9.9985	9.9476
30	0. 446	105 36	144 14	38 38	9.8927	0.0000
35	0. 445	108 11	147 3	38 52	9.8913	9.9882
222	0. 441	142 48	131 55	— 10 53	9.9921	9.9925
15	0. 439	283 11	129 58	—153 13	9.9507 n	9.9739
148	0. 438	147 26	238 19	90 53	8.1880 n	9.8383
166	0. 435	294 1	312 38	18 37	9.9767	9.7518
108	0. 435	285 34	256 58	— 28 36	9.9435	9 9367
135	0. 434	150 0	233 33	83 33	9.0505	9.9566
233	0. 430	30 12	95 12	65 0	9.6259	9.9200
136	0. 417	297 55	258 29	— 39 26	9.8878	9.8707
19	0. 414	116 33	117 21	0 48	0.0000	9.9044
128	0. 400	309 53	279 24	— 30 29	9.9354	9.8942
98	0. 400	263 50	240 12	— 23 38	9.9620	9.9809
72	0. 399	228 24	214 3	— 14 21	9.9862	9.9972
151	0. 398	273 53	224 43	— 49 10	9.8155	9.9085

TABLE OF INDIVIDUAL STARS (*continued*).

Argelander's number.	Δs	ψ	ψ'	$\psi' - \psi$	log. cos $(\psi' - \psi)$	log. sin χ
216	0″392	69°55′	92°28′	22°33′	9 9655	9.8372
75	0. 389	195 11	216 16	21 5	9.9699	9.9998
180	0. 388	180 0	300 23	120 23	9.7040 n	9.1846
245	0. 387	92 40	115 47	23 7	9.9636	9 9711
82	0. 381	205 44	222 0	16 16	9.9823	9.9794
122	0. 375	224 26	265 11	40 45	9.8794	9 9149
131	0. 372	219 42	231 29	11 47	9.9908	9.9826
142	0. 371	164 52	279 1	114 9	9.6119 n	9.8444
235	0. 369	213 34	123 22	— 90 12	7.5429 n	9.9980
18	0. 366	145 0	126 58	— 18 2	9.9781	9.9522
47	0. 363	297 22	160 3	—137 19	9 8664 n	9.9990
229	0. 361	71 25	109 23	37 58	9 8967	9.9354
184	0. 360	264 6	348 59	84 53	8.9503	9.7008
4	0. 356	92 35	118 48	26 13	9.9529	9.9680
149	0. 350	272 18	221 40	— 50 38	9.8023	9.9370
152	0. 348	141 59	292 51	150 52	9.9413 n	9.7904
165	0. 342	164 24	213 5	48 41	9.8197	9.8851
182	0. 340	151 38	327 56	176 18	9.9991 n	9.3245
183	0. 335	187 30	187 44	0 14	0.0000	9.8587
119	0. 332	256 57	249 59	— 6 58	9.9968	9.9455
167	0. 328	297 5	310 29	13 24	9.9880	9.7233
93	0. 323	179 29	234 39	55 10	9.7568	9.9969
121	0. 320	274 42	265 23	— 9 19	9.9942	9.9171
5	0. 320	95 21	113 9	17 48	9.9787	9.9464
90	0. 319	170 12	235 15	65 3	9.6251	9.9911
178	0. 318	207 40	322 41	115 1	9.6262 n	9.5065
62	0. 315	138 44	188 12	49 28	9.8128	9.8759
193	0. 314	195 45	170 1	— 25 44	9.9546	9.9348
130	0. 314	162 45	230 14	67 29	9.5831	9.9955
51	0. 314	200 52	105 39	— 95 13	8.9587 n	9.2918
38	0. 314	123 0	147 20	24 20	9.9596	9.9672
237	0. 312	187 41	114 38	— 73 3	9.4647	9.9633
239	0. 311	273 30	122 43	—150 47	9.9409 n	9.9998
174	0. 310	191 37	338 49	147 12	9.9246 n	9.8057
231	0. 310	116 6	124 17	8 11	9.9956	9.9996
208	0. 309	67 48	136 6	68 18	9.5679	9.9438
147	0. 303	230 30	224 47	— 5 43	9.9978	9.9551
172	0. 302	282 44	202 15	— 80 29	9.2184	9.8844
249	0. 298	88 16	105 33	17 17	9.9799	9.9396
248	0. 291	111 58	104 20	— 7 38	9.9961	9.9371
29	0. 290	191 42	136 56	— 54 46	9.7611	9.9444
10	0. 286	169 10	122 41	— 46 29	9.8379	9.9741
109	0. 285	332 18	253 55	— 78 23	9.3040	9.9435
56	0. 283	165 16	179 0	13 44	9.9874	9.9709
84	0. 282	121 9	244 50	123 41	9.7440 n	9.9082

TABLE OF INDIVIDUAL STARS (*continued*).

Argelander's number.	Δ s	ψ	ψ′	ψ′ — ψ	log. cos (ψ′ — ψ)	log. sin χ
197	0″281	200°50′	151°20′	— 49°30′	9 8125	9 9140
55	0. 280	115 22	175 30	60 8	9.6972	9.9375
250	0. 279	84 51	116 12	31 21	9.9315	9.9668
244	0. 279	137 34	122 19	— 15 15	9.9844	9.9992
28	0. 279	96 48	112 4	15 16	9.9844	9.8152
202	0. 277	202 41	137 22	— 65 19	9.6208	9.8560
169	0. 276	281 16	309 56	28 40	9.9432	9.6630
154	0. 274	296 27	268 32	— 27 55	9.9463	9.7252
95	0. 273	67 4	238 43	171 39	9.9954 n	9.9819
168	0. 269	177 10	302 48	125 38	9.7654 n	9.6503
44	0. 268	166 39	101 33	— 65 6	9.6243	9.6649
11	0. 267	134 47	123 22	— 11 25	9.9913	9.9668
160	0. 266	183 58	227 16	43 18	9.8620	9.8225
67	0. 265	207 1	243 1	36 0	9.9080	9.9752
6	0. 262	120 51	116 38	— 4 13	9.9988	9.9581
205	0. 258	51 54	59 26	7 32	9.9962	9.8082
34	0. 258	134 48	146 47	11 59	9.9904	9.9928
155	0. 252	291 38	267 51	— 23 47	9.9615	9.7221
194	0. 249	215 47	163 24	— 52 23	9.7856	9.9061
153	0. 249	180 0	225 1	45 1	9.8494	9.8870
139	0. 247	238 53	260 38	21 45	9.9680	9.8553
100	0. 247	158 30	240 48	82 18	9.1271	9.9806
132	0. 244	80 6	261 50	—178 16	9,9998 n	9 8777
13	0. 243	93 32	125 29	31 57	9.9286	9.9711
36	0. 240	94 5	145 5	51 0	9.7989	9.9521
25	0. 240	180 0	117 27	— 62 33	9.6637	9.8466
27	0. 239	178 5	129 3	— 49 2	9.8166	9.8990
170	0. 235	297 2	317 51	20 49	9.9707	9.6593
158	0. 235	170 55	288 57	118 2	9.6721 n	9.7295
16	0. 226	113 9	129 32	16 23	9.9820	9.9686
103	0. 222	232 29	248 31	16 2	9.9828	9 9548
171	0. 213	237 22	202 20	— 35 2	9.9132	9.8860
66	0. 213	185 42	206 16	20 34	9.9714	9.9073
209	0. 209	28 54	86 31	57 37	9.7288	9.7870
96	0. 209	187 29	242 48	55 19	9.7551	9.9663
67	0. 204	177 18	206 18	29 0	9.9418	9.9073
123	0. 201	357 49	261 3	— 96 46	9.0712 n	9.9140
57	0. 200	202 49	179 46	— 23 3	9.9639	9.9612
236	0. 197	106 33	123 16	16 43	9.9812	9.9979
87	0. 196	219 56	232 17	12 21	9.9898	9.9979
242	0. 191	168 1	122 36	— 45 25	9.8463	9.9999
48	0. 190	102 27	155 23	52 56	9.7801	9.9096
115	0. 187	237 0	238 5	1 5	9.9999	9.9917
189	0. 185	222 49	178 40	— 44 9	9.8558	9.7411
104	0. 185	355 21	279 53	— 75 28	9.3996	9.6466

TABLE OF INDIVIDUAL STARS (*continued*).

Argelander's number.	Δs	ψ	ψ'	$\psi' - \psi$	log. cos $(\psi' - \psi)$	log. sin χ
223	0″184	67°35′	67°14′	— 0 21	0.0000	9 9023
213	0. 184	188 8	119 53	— 68 15	9 5689	9.8730
50	0. 184	157 13	133 57	— 23 16	9.9632	9.5844
232	0. 182	79 45	124 5	44 20	9.8545	9.9988
116	0. 182	286 59	237 44	— 49 15	9.8148	9.9933
32	0. 179	95 27	142 24	46 57	9.8342	9.9720
54	0. 175	323 40	175 18	—148 22	9.9301 n	9.9685
17	0. 174	124 43	132 5	7 22	9.9964	9.9847
1	0. 174	223 10	122 11	—100 59	9.2799 n	9.9895
22	0. 163	111 15	133 27	22 12	9.9666	9.9654
83	0. 161	219 2	227 57	8 55	9.9947	9.9896
138	0. 154	270 0	226 22	— 43 38	9.8596	9.9934
79	0. 154	234 20	223 18	— 11 2	9.9919	9.9974
40	0. 150	115 16	151 7	35 51	9.9088	9.9411
214	0. 149	112 33	134 34	22 1	9.9671	9.9627
102	0. 149	263 26	255 21	— 8 5	9.9957	9.9365
188	0. 143	327 39	359 38	31 59	9.9285	9.4335
227	0. 137	104 55	127 2	22 7	9.9668	9.9993
42	0. 136	156 21	151 10	— 5 11	9.9982	9.8923
146	0. 133	286 38	289 3	2 25	9.9996	9.8452
230	0. 123	58 3	91 17	33 14	9.9224	9.9156
3	0. 108	76 30	123 16	46 46	9.8357	9.9931
143	0. 100	306 15	298 51	— 7 24	9.9964	9.8935
92	0. 096	288 14	249 30	— 38 44	9.8921	9.9357
41	0. 079	139 30	155 7	15 37	9.9837	9.9980